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EXPERIMENTAL CONSTRAINTS ON THE ROLE OF AQUEOUS FLUIDS IN THE ORIGIN OF B/BE VARIATIONS OF ARC MAGMAS

Shaw, HF, IGPP, L-201, Lawrence Livermore National Laboratory, Livermore, CA 94550 USA*
Brenan, JM, Department of Geology, Univ. of Toronto, Toronto, Ontario M5S 3B1 CANADA
Ryerson, FJ, IGPP, L-202, Lawrence Livermore National Laboratory, Livermore, CA 94550 USA

The B/Be ratio of many arc lavas decreases systematically with increasing depth to the Benioff zone. This trend is observed even in arcs that do not have a large sediment contribution to the B inventory of their source region (Ishikawa and Nakamura, 1994)

Calculations using mineral/melt partition coefficients (Neroda et al., 1996) indicate that >5% partial melting of mantle peridotite cannot fractionate B from Be, and cannot be the origin of the B/Be variations. Instead, the variation in B/Be ratio must be inherent in the mantle source that produces the arc lavas. It has been suggested that this variation results from metasomatism of the mantle wedge by water-rich fluids derived from progressive dehydration of the slab. For this explanation to be correct, the slab/fluid partition coefficient for B must be significantly less than both unity and that of Be.

We have determined partition coefficients between clinopyroxene and aqueous fluid at 900C and 2GPa using the procedures of Brenan et al.(1995). Clinopyroxene/fluid partition coefficients (D-B and D-Be) range from 0.010 to 0.046 for B and from 0.5 to 19.7 for Be. Both D-Be and D-B are positively correlated with the Al/Ca ratio of the clinopyroxene. Much of the reported variation in the partition coefficients is due to this effect.

If clinopyroxene is the dominant reservoir for B and Be in the mafic portion of the slab, these results imply that B will behave as an incompatible element during dehydration, while Be will be retained. Progressive dehydration of the subducting slab would result in metasomatism of the mantle wedge by high B/Be fluids in shallow portions of the subduction zone, and lower B/Be fluids in deeper portions. This is consistent with the variations in B/Be ratio of the mantle wedge inferred from the observed trends in arc volcanics.

Work is in progress to determine the role of garnet and the effect of other other solutes (e.g., NaCl)on B/Be fractionation expected during slab dehydration.

Brenan et al., 1995, Geochim. Cosmochim. Acta, v59 p3331-3350.
Ishikawa and Nakamura, 1994, Nature v370, pp205-8.
Neroda et al, 1996, EOS v77, pS281.

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